THE REPAIR OF STRICTURES OF THE COMMON AND HEPATIC BILE DUCTS*†

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THE most frequent cause of benign stricture of the hepatic and common bile ducts is the ultimate result of a direct injury to these important structures during the course of a cholecystectomy. Inadequate exposure, hemorrhage and anatomic abnormalities may result in the inadvertent ligation, clamping, or excision of part of the hepatic or choledochus during the removal of the gallbladder. The accident is not often recognized at the primary operation and only the subsequent course of events and operative findings may reveal the traumatic nature of the pathology. But operative injury alone cannot account for the complete absence of most of the common bile duct in some patients. Whipple[1] discussed three instances of irreparable stricture of the choledochus in which he felt sure that the common bile duct had not been injured at the time of cholecystectomy. When these patients had become deeply jaundiced, requiring a second operation, nothing was found but a shred of dense connective tissue extending from the duodenum to the portal fissure. He felt that such an extensive destruction of the common bile duct could only be due to the necrotizing effect of an activated pancreatic reflux. It is barely possible that the cases of chronic choledochitis described by the French surgeons in which the common bile duct resembles a pipe stem and into which a fine probe could not be introduced may be caused by repeated pancreatic reflux rather than by biliary stagnation and subsequent cholangitis. There are other cases in which merely the terminal portion of the common bile duct is strictured, the narrowing being due either to a chronic pancreatitis or to a stenosis of the papilla of Vater secondary to local ulceration.

Secondary operations upon the extra-hepatic bile ducts in general, and plastic procedures in particular, are often complicated and involved problems. They may be very time consuming and productive of shock.

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These patients require adequate and careful preoperative preparation. Surgical exploration is best performed under continuous spinal anesthesia which produces excellent muscular relaxation and renders adequate exposure. During operation a continuous infusion of 5 per cent glucose in normal saline is administered to which blood and plasma may be added. The operative findings in these cases follow a general pattern. The intra-abdominal adhesions are usually firm and dense, and at times the line of demarcation between adjacent viscera appears almost indiscernible, and only sharp knife dissection will delineate their boundaries. The liver, invariably enlarged and occasionally cirrhotic, and the omentum, are usually bound to the peritoneal surface of the anterior abdominal wall and the colon is firmly plastered to the site of the gallbladder bed. When the colon has been separated from the liver, and after the duodenum has been similarly freed, the pathology in the gastrohepatic omentum may be revealed. Occasionally the foramen of Winslow is obliterated so that the familiar anatomic landmarks are extremely difficult to identify. But if the stricture is near the termination of the common bile duct, the dilated choledochus is easily visible. If the scar is in the mid portion of the common duct, a partial narrowing may be seen with a definite enlargement of the proximal canal. However, in most of the cases, only dense scar tissue is found in the region of the hepaticus. This area, bearing in mind the close proximity of the portal vein and hepatic artery should be explored first with a fine hypodermic needle for the aspiration of bile or mucus in the syringe indicates the location of the duct. An incision is then made along the needle as a guide and the surrounding scar is carefully excised, usually exposing a shortened and dilated hepatic duct. In one of our cases the operation had to be discontinued at this point because the general condition of the patient became so precarious that further surgery was deemed inadvisable. The hepatic ducts were simply drained, leaving the restoration of biliary intestinal continuity for a later date. In patients suffering from prolonged biliary obstruction with severe hepatic damage, a two stage operation may be the procedure of choice. Attempts in most of these cases to isolate the distal portion of the common bile duct in the gastrohepatic omentum are futile, for even if it were found, the defect between the choledochus and the hepaticus and the disparity in their lumens would make any type of hepaticocholedochal reconstruction impractical.

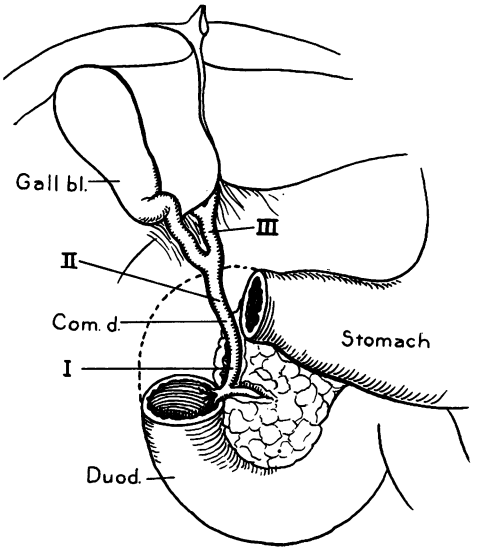

Fig. 1.—A diagnostic representation of the anatomy of the extrahepatic bile ducts.

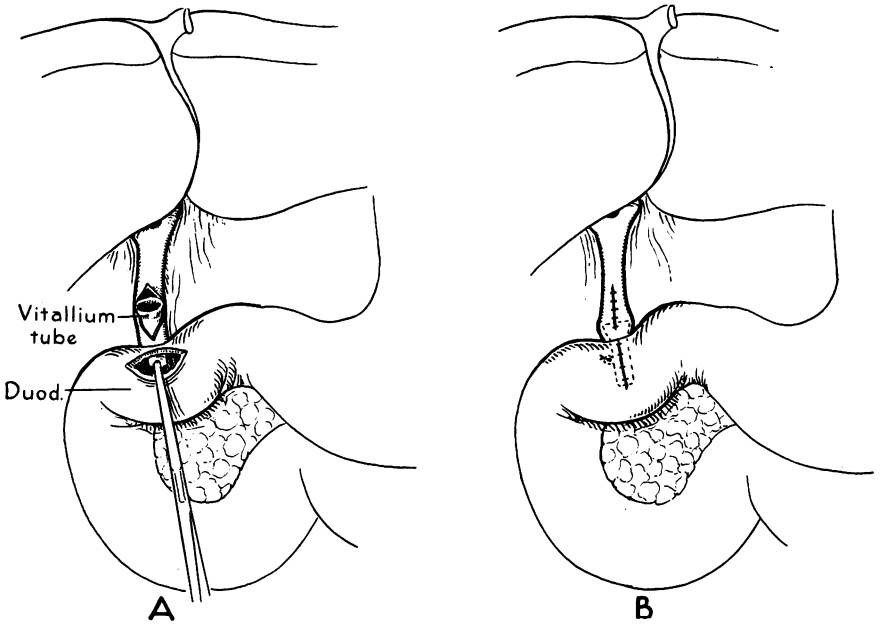

Fig. 2A & B.—Choledochoduodenostomy. A method for the introduction of the vitallium tube for strictures of the papilla of Vater and terminal portion of the common bile duct.

Once the location and the extent of the stricture has been established, a choice of operative procedure may be made, but there are certain cardinal principles which must be observed in any reconstruction of the bile ducts. It was Mayo who first emphasized the importance of uniting mucous membrane to mucous membrane in order to minimize the reformation of scar tissue and it is essential that any anastomosis between the divided duct or between the proximal duct and the intestine must be made without tension and with the maintenance of an adequate blood supply. And finally, if possible, the sphincter mechanism should not be by-passed.

The operative treatment of stricture may be arbitrarily divided into three groups (Fig. 1).

1. *The treatment of stricture of the papilla of Vater and the terminal portion of the common bile duct.*

Occasionally the narrowed sphincter may be dilated by passing graduated sounds through the common bile duct into the duodenum followed if necessary by biliary duodenal intubation. A T or straight tube is inserted via the common bile duct and sphincter into the duodenum. This tube not only provides the delivery of bile into the intestine but its mechanical presence maintains a continual dilatation of the stenotic sphincter area until the T tube is either withdrawn or the straight tube is eventually passed by rectum. If the terminal portion of the duct is compressed by a chronic pancreatitis, the sphincter and the area of stricture may be by-passed by the suture anastomosis of the dilated common bile duct to the adjacent duodenum. Choledochoduodenostomy with or without intubation has been used frequently by many Continental surgeons. While many of the gastroduodenal roentgenograms in these patients demonstrated the presence of barium or air in the common bile duct and its radicles, the incidence of clinical cholangitis was not great. Recently in a case in which a choledochoduodenostomy with intubation was performed for a terminal duct stricture due to a marked pancreatitis, cholangitis occurred within four months, and reoperation disclosed no evidence of the previous anastomosis. The funnel shaped end of a vitallium tube was then introduced into the dilated common bile duct and its other end was drawn into the duodenum, the flange being sutured to the intestinal mucosa. The openings in the common bile duct and in the duodenum were then closed (Fig. 2A & B). The immediate result has been encouraging, but insufficient time has

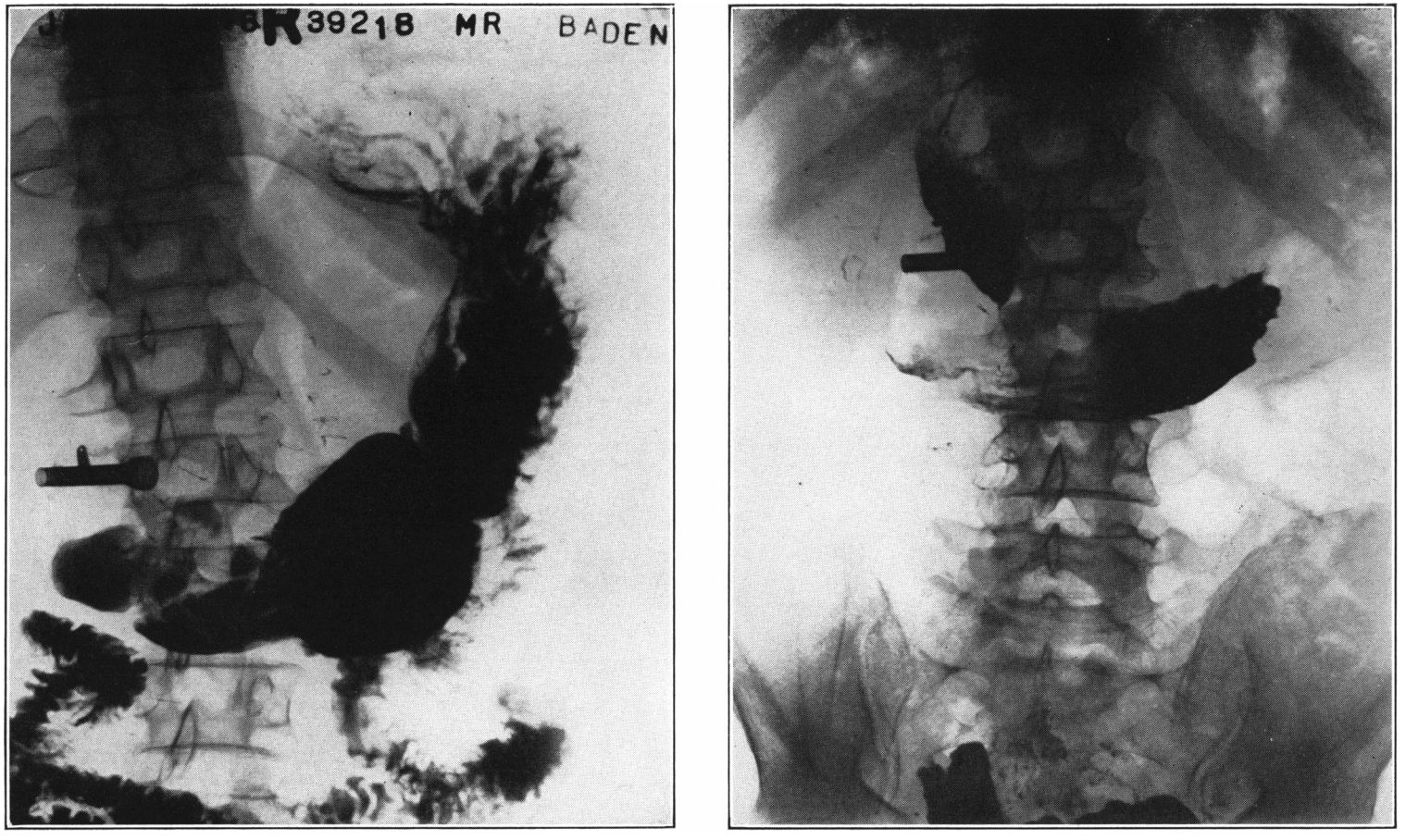

Fig. 3A & B.—A case of chronic pancreatitis with stricture of the terminal common bile duct in which a choledochoduodenostomy was performed with the aid of a vitallium tube. X-rays show the tube in place and the regurgitation of air and barium into the common bile duct and its branches.

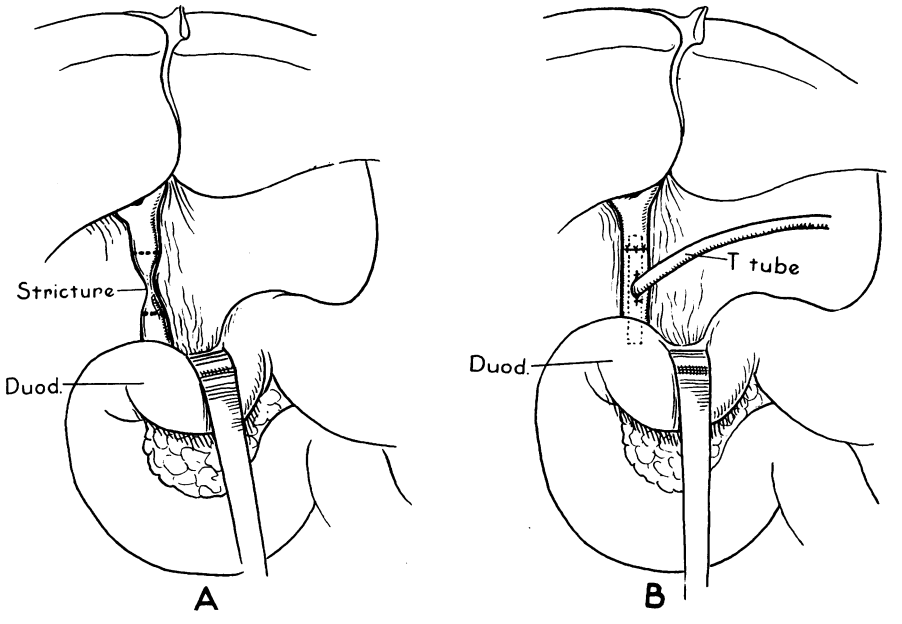

Fig. 4A & B.—A method of reconstruction of the strictured common duct, described by Cattell.

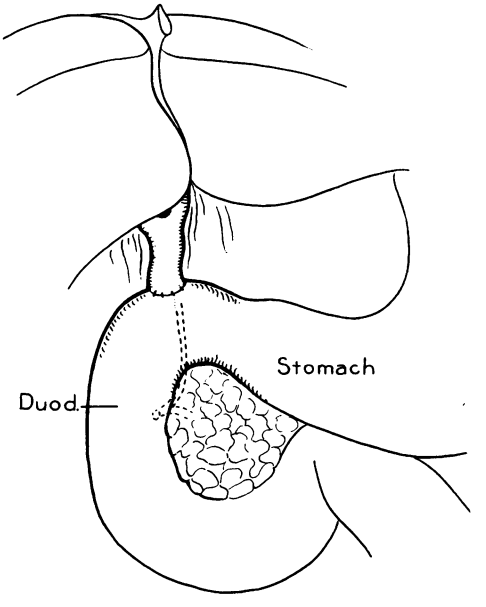

Fig. 5.—Hepaticoduodenostomy.

elapsed to determine the eventual efficacy of this procedure, for while recent roentgenograms reveal the vitallium tube in place, the presence of air and barium in the bile ducts (Fig. 3A & B) denote duodenal regurgitation.

2. *The treatment of stricture of the mid portion of the choledochus.*

In cases in which the extent of the stricture is limited, Cattell[2] recommends that the local area be resected with an end to end suture of the duct and the introduction of a T tube through a normal segment of the choledochus (Fig. 4). The T tube is subsequently withdrawn. Biliary duodenal intubation with either rubber or vitallium for large ductal defects covering the exposed tube with omentum is being used less and less. A careful review of the literature reveals no incontrovertible evidence that this plastic procedure advocated by Sullivan[3] and McArthur[4] ever results in the actual regeneration of hepatic duct epithelium,[5] and while the sphincter mechanism is maintained, the gradual and eventual contraction of the fibrous connective tissue bridge between the reconstructed duct after the tube has been expelled may result in a secondary stricture with stasis and infection. In this type of case, choledochoduodenostomy or choledochojejunostomy seems preferable.

3. *The treatment of stricture of the hepatic duct.*

In those cases in which an appreciable segment of the hepatic duct remains and the distal common duct appears obliterated, the dilated hepatic duct is freed of scar tissue and a direct suture anastomosis of the duct epithelium to the mucous membrane of the duodenum with or without intubation is done (Fig. 5). This procedure requires the minimal amount of operative trauma, and the follow-up results in these cases are not too discouraging. But in those instances in which there has been a complete destruction of the extra-hepatic bile ducts a permanent and adequate fistula must be established between the hepatic duct at the hilus and the intestine by the use of an indwelling tube reinforced by a suture of the serosa of the intestine to Glisson's capsule of the liver. The material used for intubation may be either rubber, vitallium, or tantalum. If rubber is selected, a fenestrated tube of highest quality, radio-opaque if possible and of sufficient tensile strength and calibre so that it will fit snugly into one of the hepatic ducts, is threaded on a heavy probe and introduced upwards into the liver. This tube through its side holes usually drains both ducts effectively. Its distal end, about 8 inches in length, is then passed into an opening made in

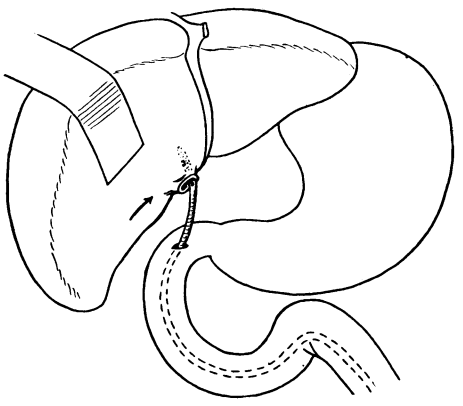

Fig. 6A. — Hepaticoduodenal Intubation. Fenestrated rubber tube inserted into left hepatic duct, and distal end directed through the duodenum toward the jejunum.

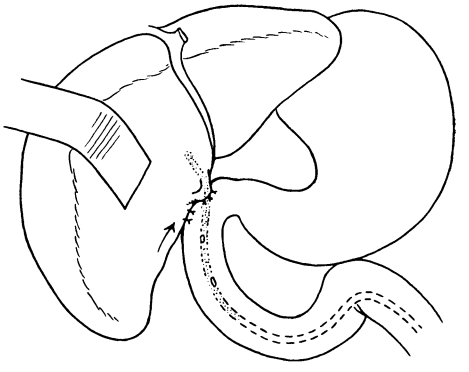

Fig. 6B.—Hepatoduodenostomy. Serosa of duodenum approximated to Glisson's capsule of the liver by interrupted silk sutures.

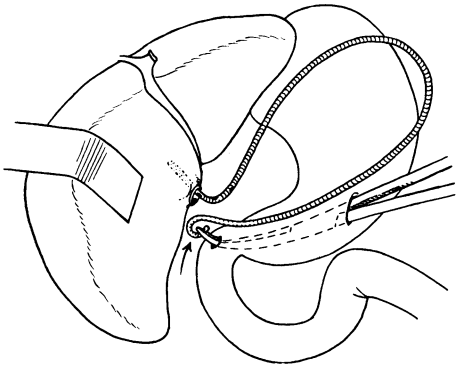

Fig. 7A. — Hepatico-duodeno-gastrostomy. Intrahepatic rubber tube pulled through a duodenotomy into the stomach by a clasp introduced through the pylorus.

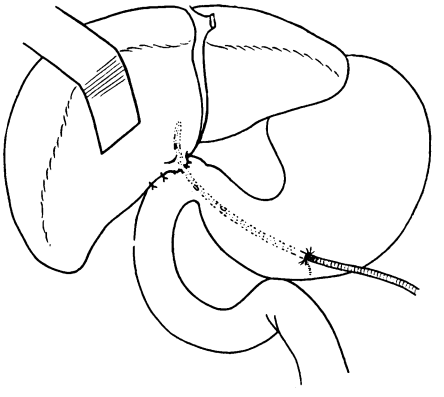

Fig. 7B.—Hepatoduodenostomy. Suture of the duodenum to the liver with interrupted sutures. End of tube made to emerge from stomach similar to a Kader Stamm gastrostomy.

the opposing duodenal wall and directed preferably in the direction of the jejunum (Fig. 6A & B). However, the tube may be pulled through the pylorus and brought out of the anterior wall of the stomach, similar to a gastrostomy (Fig. 7A & B). Interrupted sutures of linen or silk then approximate the serosa of the duodenum to Glisson's capsule of the liver in the region of the intubation. Posterior and lateral sutures are tied before the anterior group is introduced. The area is then drained by rubber dams which emerge through a small right subcostal incision.

In the majority of our cases a complementary Kader Stamm jejunostomy for alimentation was performed, the enterostomy tube being drawn through a left lateral stab wound.

The immediate postoperative complications in cases of anastomosis of hepatic duct to the duodenum, or the suture of the liver to the intestine with hepatico-intestinal intubation, may be due to leakage at the site of the anastomosis which may result in a biliary or intestinal fistula, or a generalized peritonitis. Drainage has largely eliminated the latter as a complication. Occasionally there was a temporary seepage of bile which soon disappeared within a few days. In one of our cases, a debilitated female, 69 years of age, who had had three previous attempts at reconstructive procedures, the early and partial separation of the duodenum from the surface of the liver within 48 hours, resulted in a fatal peritonitis. In another case a dehiscence of the duodenal suture developed which terminated in a right subphrenic abscess and a massive empyema with multiple loculations. During the period in which the duodenal fistula was active, the intestinal secretions were aspirated by continuous suction and the chemical balances were regulated by the introduction of the aspirated contents, pabulum and electrolytes through the jejunostomy.

The use of the rubber tube in biliary duodenal intubation undoubtedly has some advantages and a few possible late disadvantages. The tube, because of its pliancy, is easy to handle and adapts itself to the mechanical conditions present. It relieves the obstructive jaundice. Its presence not only prevents an edema occluding the anastomotic site but in addition it acts as a supporting scaffold until the union between the duct and duodenum is firm. In the majority of reported cases, and in ours, the peristaltic activity of the intestine was sufficient ultimately to discharge the tube which was eventually passed by rectum in three to twelve weeks after operation. Some of the patients were unaware that the tube had been eliminated although x-ray examination failed to reveal its presence. On the other hand the tube may be retained indefinitely. It may be subsequently plugged with bile salts and then the resultant biliary stasis favors ascending infection. Judd[6] reported the retention of a tube for four years when a cholangitis developed which necessitated its removal two years later. However, innumerable occasions have been offered to examine tubes which have been retained for a year or more. Many of these are in a state of good preservation and

relatively free from encrustation and from the disintegrating effects of bile salts. Andrus[7] cited a case in which the tube had been in place for eight years and still seemed to be serving its initial purpose. It would seem desirable to be able to control the passage of the tube but older methods in which this was attempted were discarded because they were unsatisfactory. In one of our cases in which the distal end of the biliary duodenal tube was brought through the pylorus and then out of the stomach, so that theoretically it could have been withdrawn at will, the early development of a gastric fistula necessitated its removal on the eleventh day. The premature removal of the tube in this case at a time before a firm anastomosis had been established was probably the reason for an early recurrence of a secondary stricture and cholangitis.

Pearse,[8] in order to eliminate some of the objectionable features of rubber, used vitallium tubes of various sizes and shapes especially designed to meet the particular mechanical conditions encountered in strictures of the extra-hepatic ducts. He found that this metal did not corrode and bile salts did not precipitate on its walls. Experimentally he noticed that the mucous membrane lining the tube failed to show any reaction although the mucous membrane did not grow into the metal tube. But he added there was a general tendency for all tubes used in this work to eventually pass into the intestinal canal. Undoubtedly a metal tube, with a flange at its center and funnel shaped at one end, introduced into the hepatic duct, may remain in place and maintain its patency for a longer period of time than a rubber tube. However, recently Bettman and Tannenbaum[9] found it necessary to remove a 1 inch vitallium tube which they had implanted in a strictured common bile duct because the lumen was entirely plugged with a greenish deposit. Moreover, a rigid vitallium tube in certain locations may be more difficult to handle than rubber, and the use of vitallium per se will probably not reduce the incidence of ascending infection from regurgitation, even though it maintains an adequate lumen between the liver and the intestine.

In a group of seven patients in whom a hepatoduodenostomy with hepaticoduodenal intubation with a rubber tube was performed, there was one death from a generalized peritonitis due to a duodenal leak. Five of these patients have been previously reported in detail.[10] There were four patients who after an immediate postoperative period have remained well and have never experienced any clinical evidence of an

ascending infection. One patient has been followed for five years, one for three years, one for two years, and one for five months. In the remaining two patients, persistence of a mild icterus has been noted and attacks of Charcot fever have been frequent, in one for the past four years and in the other for about two and a half years. At the onset the attacks were partially ameliorated by stimulating the intestine and the flow of bile by the use of saline cathartics and the infection was partially controlled by the careful administration of chemotherapeutic and antibiotic agents. In both these patients a recurrent stricture with chronic cholangitis is probably present. One patient was re-operated without success and the other has refused further surgery.

This serious complication of ascending infection due either to a recurrent stricture with biliary stasis or to intestinal regurgitation into the biliary radicles of the liver is always a possibility in any reconstructive procedure of the hepatic or common bile ducts, especially in those instances in which the sphincter mechanism has either been side tracked or eliminated. Over twenty-five years ago Eliot[11] stated that "the dangers of ascending cholangitis varies directly with the distance from the site of the papilla through which a new opening in the intestine was made. The result of subsequent regurgitation of intestinal contents is small if the end of the divided duct or the rubber tube in cases of reconstruction is passed obliquely (Witzel) through the intestinal wall. The risk of postoperative leakage, the subsequent formation of a duodenal fistula is also diminished by this procedure. For the purpose of still further decreasing these postoperative complications, provisions may be made for the insertion of the end of the divided duct, or in cases of reconstruction, of the rubber tube into a portion of the small intestine which has been excluded from the path of the intestinal contents by a simple entero-anastomosis or by a more complicated procedure," i. e., the Roux principle of intestinal anastomosis. At that time this procedure was rarely performed because the general condition of the patient did not permit a prolonged operation in view of the longstanding pre-existing jaundice. Today, however, the preoperative use of vitamin K, transfusions of blood and plasma, and the high protein and carbohydrate diet have practically eliminated the dangers of cholemia and have made these prolonged operations feasible.

In intractable cases of ascending infection following previous reconstructive procedures, it may become imperative to divert the flow

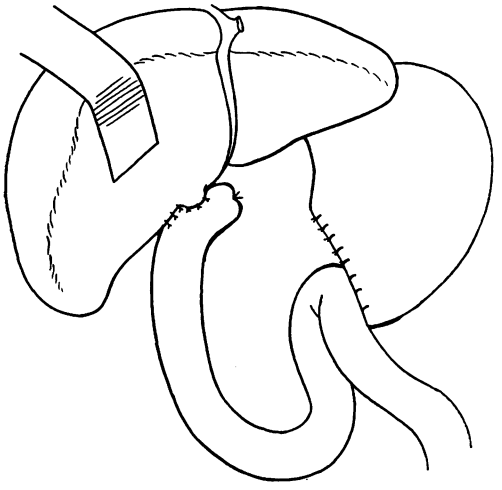

Fig. 8.—Subtotal gastrectomy of Billroth II type following hepaticoduodenostomy.

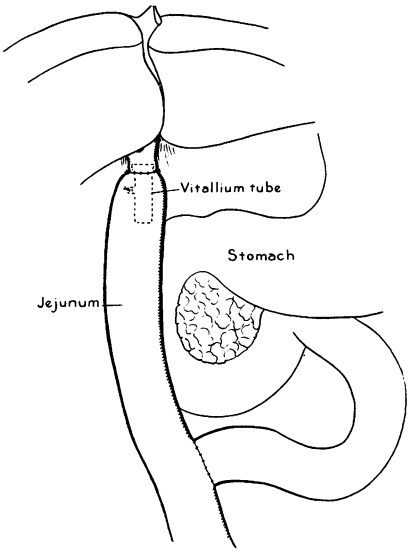

Fig. 9.—Hepaticojejunostomy over a vitallium tube with Roux Y type of intestinal anastomosis.

of the intestinal contents and eliminate the factor of regurgitation. In cases in which a hepaticoduodenostomy has been done, Finsterer suggested that the gastric contents should be side tracked by a subtotal gastrectomy of the Billroth II type (Fig. 8). This was done in one of our cases without any relief, but it is likely that this procedure was ineffectual because the infection had already become too firmly entrenched in the finer biliary ducts of the liver. The seriousness of ascending infection has been vividly re-emphasized in the past few years in those cases in which the enlarged gallbladder was anastomosed to the stomach following radical resections of the duodenum and the pancreatic head. In an effort to diminish the incidence of cholangitis and multiple liver abscesses which often terminated fatally, the severed dilated common duct was implanted into a loop of jejunum in which the food current was diverted either by an entero-enterostomy or preferably by a Roux Y type of intestinal anastomosis performed at some distance from the point of implantation. This latter procedure, advocated by Whipple,[12] Child,[13] and others, seems to have materially reduced the incidence of the Charcot syndrome. Recently, Cole, Ireneus, and Reynolds[14] have reported several cases in which the choledochus was almost

completely destroyed and in which a vitallium tube inserted in the hilar stump was anastomosed to the single arm of the jejunum utilizing the Roux principle. Then to further reduce the amount of intestinal regurgitation a series of intraluminal jejunal valves was constructed. This procedure has apparently eliminated attacks of cholangitis. The operation described by Coe was recently used in a case of biliary bronchial fistula secondary to a stricture of the hepatic duct. Unfortunately this patient developed a secondary hemorrhage on the second day from an arterial vessel injured at the time of operation, and she succumbed nine days after operation. There was no post mortem. The second patient, aged 22, was operated upon recently by P. Klingenstein.[15] She presented a stricture at the porta hepatis and following the implantation of a vitallium tube into the blind jejunal loop she made a good recovery and at present is convalescent. No further x-ray studies with barium have been made.

Comment

As the literature of reconstructive procedures for strictures of the common and hepatic bile ducts is reviewed, and one's personal experiences are studied, certain depressing facts become apparent. It is evident that the operation of cholecystectomy is not a simple innocuous procedure because the most frequent cause of benign stricture is the accidental injury of the ducts during the removal of the gallbladder. Stricture of the extra-hepatic ducts resulting in biliary obstruction and infection is an exceedingly serious condition. Various plastic procedures designed to restore biliary intestinal continuity are extremely difficult and are attended by an appreciable operative mortality. Furthermore, the follow-up studies of these patients reveal that many suffer from the effects of the local reformation of scar tissue and from ascending infection. Therefore, any reconstructive procedure which will maintain the calibre of the duct and the sphincter mechanism is greatly to be desired. Unfortunately the pathology in the majority of cases makes this impractical. In many cases it becomes necessary to anastomose the extra-hepatic duct or its hilar stump preferably to the duodenum or the jejunum over a tube. For intubation, rubber, vitallium, or tantalum may be used. Biliary intestinal intubation provides the immediate relief of the obstructive jaundice and should act as an intraluminal support until the anastomosis is firmly healed. The vitallium tube is favored at present

because it is retained longer, and is less apt to be clogged by the precipitation of bile salts but its presence per se does not diminish the incidence of either duodenal or jejunal regurgitation, a factor in the production of the Charcot syndrome. The reason why certain patients will develop attacks of ascending cholangitis in the presence of an adequate biliary intestinal fistula is not clear. The fact that some of these patients may be subsequently relieved of cholangitic episodes by secondary operative procedures in which the intestinal current is diverted and the degree of regurgitation reduced raises an important question. Should the operation of hepaticoduodenostomy or hepatoduodenostomy with hepaticoduodenal intubation be continued as a primary procedure, performing at a later date if necessary a subtotal gastrectomy of the Billroth II type to divert the gastric contents in cases of ascending infection, or should these cases be treated initially by hepaticojejunostomy or hepatojejunostomy with intubation, utilizing the Roux principle of intestinal anastomosis with the hope that the primary diversion of the intestinal content will lessen the incidence of cholangitis? This is a fundamental problem which only the following results in these respective groups of surgical procedures will decide.

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